PVC Chemistry

Anna Pla-Dalmau
Fermilab

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PVC: GENERAL REMARKS

- PVC degrades easily
  - Heat sensitive polymer (>100 °C, UV or γ-rays)
  - $-(CH_2\text{-}CHCl)_n- \rightarrow -(CH{=}CH)_n- + n\,HCl$
  - HCl and O_2 accelerate decomposition
- Additives:
  - To compensate for processing shortcomings
  - To meet product requirements
- Manufacturers:
  - Georgia Gulf
  - POLYONE
  - Smaller: Clariant, Prime

PVC: GENERAL REMARKS

- Wide variety of commercially available resins
  - Processing methods and end properties
  - Molecular weight (K-value) influences both
  - Low K-values easy to process
  - Rigid PVC, no K-value > 70
  - K-value affects porosity
- Unplasticized, rigid PVC:
  - Good chemical properties
  - Resistant to aliphatic hydrocarbons (oils and waxes)
  - Low water absorption

NOT JUST PVC!!!

ADDITIVES (performance, processing and cost)

- Heat stabilizers (essential): organo-tin, Ca-Zn, Pb
- Lubricants (processing)
  - External – to work at the interface polymer and metal
  - Internal – to lower shear viscosity
- Processing aids: PMMA, SAN (affect shear visc.)
- Impact modifiers (NO): ABS, rubbery materials
- Fillers (NO): $CaCO_3$, glass fibers
- Pigments (YES): TiO_2, best performance
- NO: Plasticizers, UV-absorbers, antioxidants (?)

PVC COLOR CONCENTRATE

- TiO_2 – white pigment
  - Rutile – (chlorine process)
  - Anatase – (sulfate process) better reflective, less scat.
  - ZnO, MgO degrade PVC
- TiO_2 concentrate
  - 60% TiO_2
  - Ca-stearate (multi-function: stability, rheology)
  - 6% acrylic-based processing aids
  - 20-30% PVC resin: low molecular weight (water clear)
- Black PVC coating:
  - 2% Carbon Black